# CHAPTER I

# INTRODUCTION

## 1.1 General

The study of soil-structure interaction problem is of considerable importance for both structural and geotechnical engineering. The results obtained from this problem are very useful for the analysis and design of foundations as well as the analysis of stresses and displacements in the soil medium. For example, the model of a plate resting on or buried in a soil medium under dynamic forces (e.g. vibrating machines, seismic waves, etc.) can be used in the analysis and design of mat and raft foundations, anchor plates resisting uplift loads and theoretical modeling of some in situ testing methods.

During the last 30 years, researches on the dynamic soil-structure interaction have received wide attention due to their importance in the field of earthquake engineering, structural dynamics and geomechanics. Therefore, a lot of researchers have studied this problem by employing a variety of analytical methods, such as integral transform methods, power series, Fourier series techniques and variational methods, as well as numerical methods, such as Finite Element method (FEM) and Boundary Element method (BEM).

Most of the existing studies on dynamic soil-structure interaction problems considered a soil medium as a homogeneous elastic half-space. However, a soil medium is generally a two-phased material consisting of a solid skeleton with voids filled with water. Such material is commonly known as a poroelastic material and widely considered as a much more realistic representation for natural soils and rocks than an ideal elastic material. Moreover, natural soil profiles are normally layered in character with different properties. Therefore, the representation of a soil medium as a multi-layered poroelastic half-space is more appropriate for natural soils and rocks.

In this thesis, the problem of a circular elastic plate resting on or buried in a multi-layered poroelastic half-space subjected to axisymmetric time-harmonic loading as shown in Figure 1 is considered. This problem is solved by using an elastodynamic principle and discretization technique. A computer program has been developed for solving this interaction problem and investigating the influence of various parameters on the dynamic response of the plate.

### 1.2 Objectives of Present Study

The objectives of this thesis are the following:

1) To derive the Green 's functions of a multi-layered poroelastic half-space corresponding to the axisymmetric time-harmonic loading and fluid sources.

2) To study the dynamic response of an elastic circular plate interacting with a homogeneous and a multi-layered poroelastic half-space and to investigate the effect of various parameters e.g. plate rigidity, poroelastic material properties, frequency of loading, etc. on the plate response.

3) To develop a computer program for solving this dynamic interaction problem.

### 1.3 Scopes of Present Study

This thesis is concerned with the study of the dynamic interaction between a plate and a poroelastic half-space. The plate under consideration is an elastic or a rigid circular plates. Two types of poroelastic half-space, i.e., a homogeneous poroelastic half-space and a multi-layered poroelastic half-space, are considered. The contact surface between the plate and the half-space is either fully permeable or impermeable. Only axisymmetric time-harmonic vertical loading is considered in this study.

### 1.4 Basic Assumptions

The dynamic interaction between the circular plate and the poroelastic hlaf-space considered in this study is based on the following assumptions:

1. An elastic circular plate behaves according to the classical Kirchoff theory.
2. Each layer of a multi-layered poroelastic half-space is homogeneous, isotropic and governed by Biot 's poroelastodynamic theory.
3. The plate is assumed to be in perfect contact with the supporting half-space, i.e., no separation occurs.
4. The contact surface between the plate and the half-space is assumed to be smooth.